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ABSTRACT

Presented are guidelines for preparing teachers of reading with the Optacon -- an electronic device which tactually reproduces printed letters thus allowing the blind to read regular print. The course outline includes objectives and recommended instructional activities for each of the following phases: introduction and use of equipment, instructional strategies, assessment, instructional materials, psychoeducational factors, and research needs. Specific objectives include the following: demonstration of the Optacon, Visual Display, and Tracking Board; presentation of information theory concepts including definition of critical features; discussion of research on characteristics of successful Optacon readers; presentation of an overview of training materials available; a discussion of vocational, education, and sociological considerations relating to the Optacon; and a discussion of questions which research needs in tactual reading. Appended are the course outline, a daily schedule, sources of materials, an article about the Optacon reader, and a bibliography of material suitable for easy reading with the Optacon. (DB)

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GUIDELINES FOR THE PREPARATION OF TEACHERS

OF

READING WITH THE OPTACON

Editor
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School of Education
University of Pittsburgh
Pittsburgh, Pennsylvania

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INTRODUCTION

Special Project.

The Bureau for the Education of the Handicapped of the U.S. Office of Education awarded the University of Pittsburgh a grant for a Special Project on Teaching Reading with the Optacon. The Special Project participants represented ten Colleges and Universities with programs in the Professional Preparation of Teachers of the Visually Handicapped, and a consultant from Telesensory Systems, Inc. (See List of Participants, p. 4). This document, Guidelines for the Preparation of Teachers of Reading with the Optacon, was prepared as a product of the grant and represents the contributions of the participants, summative consensus by participants, and a curriculum previously developed at the University of Pittsburgh as a result of formative evaluation procedures conducted since 1973.

Antecedent Activities.

In 1973, the Richard King Mellon Foundation supported a two year project to provide Optacons (for description of the machine, and its development, see section 1.0) to blind persons in the Pittsburgh region, and to demonstrate the Optacon's usefulness in such a way as to encourage other agencies to include reading with the Optacon as a part of their own programs in education and rehabilitation. The project was organized in three parts: teacher preparation, instruction for Optacon users, and subsidy for purchase of Optacons by people who

successfully demonstrated competence in reading with the Optacon.[1]

The Department of Special Education and Rehabilitation, University of Pittsburgh (now designated Program in Special Education in the Division of Specialized Professional Development) received a grant as a part of the Richard King Mellon Foundation project for the purchase of equipment and professional preparation of teachers to teach reading with the Optacon. Under the terms of the grant, Dr. Mary W. Moore attended a two week training program at Telesensory Systems, Inc., Palo Alto, California. Eleven complete sets of equipment, including Optacons, Visual Displays, training accessories and training manuals were purchased, and three Special Study Institutes were conducted to provide more than thirty teachers to staff the Optacon Programs being initiated in agencies and schools throughout the Pittsburgh region. The project demonstrated a feasible plan for teacher preparation and instruction to students.

In 1974, the Department of Education of the Commonwealth of Pennsylvania utilized the experience gained through the original Pittsburgh

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1. The value of the Optacon was previously reported by:
Goldish, Louis H. and Taylor, Harry E. The Optacon: A Valuable Device for Blind Persons. The New Outlook for the Blind, February, 1974.

Weisgerber, R.A. et al. Educational Evaluation of the Optacon, Interim Technical Report, Phase I. Contract No. OEC-2-72-5180.

project to initiate the Pennsylvania Optacon Project.[1] This new project provided a model through its Steering Committee and the Pennsylvania Materials Center for the Visually Handicapped for expanded demonstration and dissemination of innovative instructional processes on the State level. The Pennsylvania Optacon Project has provided facilities for teaching of reading with the Optacon in all regions of the state. It has further expanded ideas generated in the Pittsburgh region to include a network for the gathering of empirical data and the evaluation, development and dissemination of curricular materials and instructional information.

Projected Activities.

An unprecedented situation presently exists within the educational system. The development of this instructional machine as well as its demonstration and dissemination is an example of unique combinations, or symbiotic relationships, between federal government, industry, private philanthropy, university, and local and state school systems. The interest and support of these various factions has considerably reduced the usual lag between development of an instructional aid to implementation in the classroom enhancing the education of students.

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1. Moore, Mary W. 1974-75 Report of the Pennsylvania Optacon Project for Teaching Reading to Visually Handicapped Students. University of Pittsburgh. Pittsburgh, Pennsylvania.

The Special Study Institute reported in this document has contributed to the unprecedented situation previously mentioned. Now that faculty from ten additional colleges and universities have participated in the Special Project, a nucleus of institutions are interested in including in their teacher preparation programs the Teaching of Reading with the Optacon. These institutions could form natural clusters from which a National Model in Demonstration and Dissemination in education could be accomplished. Such a projected plan should be proposed and highest priority directed to its implementation.

Project Participants.

The ten participants, one TSI consultant, and an additional faculty member contributing to this document include:

Dr. Robert A. Bowers, Teachers College, Columbia University, New York

Ms. Ruth H. Craig, Brigham Young University, Utah

Mr. Humberto Hernandez, University of Puerto Rico, Puerto Rico

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Dr. Ouida Fae Morris, Boston College, Massachusetts

Dr. Grace Napier, University of Northern Colorado, Colorado

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Mr. Paul E. Liniak, Telesensory Systems, Inc., Palo Alto, California

Dr. Ralph L. Peabody, University of Pittsburgh, Pittsburgh, Pennsylvania

Curricular Considerations for Teacher Preparation.

To date, 132 persons have completed Special Study Institutes or Courses in the Teaching of Reading with the Optacon at the University of Pittsburgh. Each of these Institutes or Courses were carefully evaluated, resulting in a rather dramatic evolution based on formative evaluation. The curricular content reported represents the iterative evolution from the earliest Institutes to and including the contributions of the participants in the Special Project and their summative consensus.

Organization of Guidelines.

This document is intended to serve as a guide to materials and activities which may be included in workshops for the professional preparation of teachers of reading with the Optacon, following the course outline developed by the participants in the Special Project (See Appendix). References to detailed technological descriptions of the Optacon and accessories, reviews of theoretical considerations, and results of research and evaluation studies which have been reported in the literature are included with each section. Workshop Directors are encouraged to become thoroughly familiar with this literature and to provide appropriate selections for the students who are participating.

Teachers of reading print with the Optacon should, upon completion of the workshop, possess the following competencies:

1. Knowledge of appropriate instructional strategies for teaching reading with the Optacon.
   Students will:
   - Demonstrate check-out procedures
   - Free track on a variety of materials
   - Adjust equipment for reading differing print sizes and styles
   - Demonstrate use of accessories
   - Teach recognition of letters to blindfolded colleagues or blind subjects, displaying knowledge of information-bearing characteristics of letters

2. Knowledge of appropriate curriculum development
   Students will:
   - Construct sequentially ordered list of instructional objectives
   - Demonstrate use of above list for selection and preparation of materials

3. Knowledge of construction, administration and interpretation of diagnostic and assessment instruments
   Students will:
   - Demonstrate use of sequentially ordered instructional objectives for assessment and diagnosis by construction of selected lesson plans.

Dr. Ralph L. Peabody

1.0 INTRODUCTION AND USE OF EQUIPMENT

OBJECTIVES:

1.1 Workshop Director will demonstrate Optacon, Visual Display, and Tracking Board.
- 1.11 Student will set up equipment for teaching station, following the Workshop Director's instructions.
- 1.12 Student will perform check-out procedures.
- 1.13 Student #1 will introduce to Student #2, who is under blindfold, all parts of the equipment.

1.2 Workshop Director will review history of the development of reading machines for the blind.

1.3 Workshop Director will demonstrate correct tracking procedures and position of image.
- 1.31 Student will perform check-out procedures and adjust magnification and threshold controls for Lesson Two of TSI Stage I Manual.
- 1.32 Student will practice tracking of Lesson One and Lesson Two of TSI Stage I Manual, using tracking board.

1.4 Workshop Director will demonstrate accessories: Master-Monitor Cable, Automatic Page Scanner, Calculator Lens Module, CRT Lens Module, Magnifier Lens Module, Typewriter Attachment.

1.1

A teaching station for Optacon instruction consists of the Optacon, a Visual Display, Tracking Aid, and a set of Instruction manuals. The Visual Display is an accessory which is used only for teaching, and presents the same electrical signals in visual form which are presented to the learner in tactual form. The sighted instructor can utilize the visual display to check the position and clarity of the tactual image which is under the finger

of the learner. The Tracking Board is utilized in the early instruction of readers for the development of good camera tracking skills and enables the instructor to assist the learner in making fine camera movements.

The Optacon itself is about the size of a portable cassette player, and weighs less than four pounds. A fitted soft pack is provided as extra insurance against damage when the Optacon is to be stored or carried in traveling. If the Optacon is to be shipped or to travel as checked luggage, it should be in the soft pack which is in turn suspended in foam in the original shipping carton. In individual compartments in the soft pack, are the Optacon, an adjustable leather strap which is to be attached to the leather case housing the Optacon, and the battery charger. When the student is familiar with the soft pack, the Optacon and the battery charger can be removed and the pack stored away from the teaching station. While learning to operate the equipment, the student will not need the carrying strap, which can remain in the soft pack.

Inside the leather covering of the Optacon is a metal chassis which contains the electronics of the instrument. The leather case need never be removed, however, the student may wish to investigate the inner metal chassis and no harm will come from removing it for this purpose. The student should be cautioned, however, that repairs will not be made to the Optacon under the warranty or service agreement if there is evidence that the metal chassis has been opened and the teacher should make sure that children whom they are teaching never try to open this metal chassis.

When the student has become familiar with the size, shape and weight of the Optacon, the workshop director can direct his further investigation of the instrument. The leather case has two openings at the back of the Optacon to enable access to the panel of controls on the metal chassis; the Battery Charger, Battery Check button, Normal/Invert Switch, and I/O (Input/Output) Connector.

The power to run the Optacon comes from a rechargeable battery within the main chassis. This battery, when fully charged, should run the Optacon for approximately four hours of normal use. Time to recharge will be roughly twice discharge time. The battery charger which accompanies the Optacon is the only charger which should be used with the instrument, and replacements should come from TSI. No harm will come from using the Optacon with the battery charger connected during instruction. This will supply some power and extend the discharge time of the battery. (It is normal for the charger to become warm when plugged in). Not all the power is supplied however, and the battery will still require routine recharging. Before each teaching session, a battery check should be made. With the battery charge disconnected and the Optacon on, Battery Check button on the back panel is depressed. If the tone of the Optacon rises in pitch or stays the same, the battery has enough charge to operate. If the tone goes down, the battery should be recharged.

The Normal/Invert Switch is usually set in the Normal position. This enables the student to read black (or dark colored) print on white (or light colored) background. If the Normal/Invert Switch is set at the Invert position,

the electrical signals from the camera are reversed, and the student can read white (or light colored) print on black (or dark colored) background and electronic readout displays such as the calculator. The position of this switch should be routinely checked. The switch must always be completely at one end or the other of the slide, or the Optacon will not operate.

The I/O Connector is used for the attachment of the Visual Display, Repeater Cable, etc. On either end of this Connector is a male or female plug. The attachment should be lined up with these plugs, and the connection made by rocking in sideways to keep the pins from being bent. The student should be cautioned to check that all switches on the equipment are Off before any attachments are made. The Visual Display does not have a power supply of its own, and must be connected to the 110 power line to operate. The student may make connections for the Visual Display at this time, while the Optacon is in the back-front position as this is usually difficult for most sighted students to accomplish tactually. The Battery Charger connection, Battery Check and check of the Normal/Invert Switch can be accomplished tactually.

When the Optacon is turned around with the rounded end forward, and the leather flap is opened, the camera, front control panel and tactile array are revealed. On the front control panel is an Off-On Switch. The student should turn the Optacon to On position and check the battery; then, with the Optacon in the Off position, the battery charger may be connected to the Optacon and to the power line.

The camera rests in a grey plastic holder on the shelf at the left side of the

Optacon. Instructions for removing the camera accompany the Optacon, and these instructions should be followed carefully. The cable which connects the camera to the Optacon contains over 30 tiny wires. If the cable becomes very twisted, or if too much strain occurs at the points of connection, a wire or a connection may be broken. The student should form the habit of carefully straightening the wire, much as a telephone wire is straightened, before operating the instrument.

The camera is in two parts. The front end, furthest from the cord connection, is block shaped, and contains the optical lens system. The back end, nearest to the cord connection, is cylindrical and contains the phototransistor system. On the under side of the camera, near the front end, is the camera aperture. On either side of this aperture are two lights which illuminate the print. These lights are carefully balanced in intensity, and should be checked from time to time to note that they are of equal brilliance. If lights are below normal brightness, the battery may need recharging. Light reflected from the page is focused by the zoom lens system within the camera onto the phototransistor system. The student should turn on his Optacon briefly and inspect the lights. Then turn the Optacon off. Toward the back end of the under side, also, are two rollers. As the camera is moved, the rollers should be flat on the page which helps to keep the camera straight across the line of print.

On the top side of the front end of the camera is the magnification control. When the button is slid forward, the size of the image increases; when

slid backward, the size of the image decreases. The image which the reader receives should be kept always the same size; the magnification control enables the adjustment for different sized print.

The cylindrical section at the back end of the camera is called the "Silicon Retina Module". It may be detached from the rest of the camera by pushing in on the module, twisting counterclockwise to unlock, then pulling the module away. Be sure that the Optacon is turned off before detaching the retina module from the rest of the camera system. Inside this module can be viewed a tiny chip approximatley 1/4" x 3/8". This chip contains 144 phototransistors arranged in a matrix of 6 columns and 24 rows. If the student reinserts the Silicon Retina, turns on the Optacon and Visual Display, the same matrix can be seen on the Visual Display.

The electronics of the Optacon perform a "light-dark" decision on each signal received from each phototransistor. If the signal exceeds a threshold level, a "light" decision is made. Conversely, if the signal is lower than the threshold level a "dark" decision is made. In the Normal mode, a dark decision signals a corresponding pin on the tactile array to vibrate. In this fashion, whatever is dark (print) on the page is focused by the lens system onto the phototransistors in the same pattern, which in turn produces a vibratory image of the same pattern on the tactile array.

The Silicon Retina Module is detachable from the rest of the camera for several reasons. Alternate lens modules which enable use of the accessories may be attached. In addition, for normal reading, the module is inserted with the

cord coming from the under (roller) side of the camera. The camera is held with the cord toward the reader's body. For some tasks, e.g., reading cards in a library drawer, or reading a sheet of paper in the typewriter, the retina is rotated 180° with the cord coming from the top (magnification button) side of the camera, and the camera may be inverted with the cord away from the reader's body. This enables the reader to scan left to right as usual, but allows the camera to be inserted into tight places.

When the camera is not in use, it should be placed in the holder on the Optacon with the cord toward the back of the Optacon. There will then be less chance of the reader accidently pulling the camera off the table and damaging it.

On the right side of the front panel of the Optacon are two additional controls. The upper knob controls the intensity of vibration of the pins on the tactile array, and incidentally, the sound of the vibration. The intensity required by the reader for accurate perception varies with each individual, however, when the child is first introduced to the Optacon, the knob may be set at approximately two o'clock. A small button on the knob provides a tactual indication of the setting.

The lower knob controls the threshold level of the Optacon. As the knob is turned clockwise, the strokes of the individual letters will appear wider. (In the Invert mode, the effect of turning the threshold adjustment knob is reversed). The ideal threshold may vary frequently and it is important for the student to develop his ability to adjust it.

When small print is magnified, not only the size of the image enlarges, but the width of each stroke is increased, the effect sometimes being the production of a large "mushy" image in which the critical features such as openings and diagonal lines are not clearly defined. There is, therefore, a fairly delicate interaction between the adjustment of the magnification (with the index finger of the right hand) and the adjustment of the threshold (with the thumb of the left hand). Generally, as the magnification is increased, the threshold must be decreased.

While thin stroked letters are usually easier to read than thick stroked letters, variations in print may make it necessary to increase the threshold above the ideal. Some letters are printed with variable stroke widths, and on some the ink may be unevenly distributed. The state of the battery charge may also affect the degree of threshold required.

On the shelf on the left side of the chassis is the tactile array. The tactile array consists of 144 pins which protrude through holes in a curved plastic fingerplate and which are arranged in the same matrix of six columns and 24 rows as the phototransistors. The vibration of these pins is accomplished through a principle resembling the principle of the phonograph needle. The phonograph needle (embedded in a crystal) rides in the grooves of a record; i.e., mechanical energy is converted to electrical energy. An inverse principle is utilized with the tactual array; the phonograph crystal in this case is a bar which is tied down (piezoelectric reed), and to the end of this bar is mounted a pin which vibrates at 250 Hz.

Behind the tactile array on the right hand wall, is a circuit breaker which acts as a fuse. The Optacon may be shipped with the breaker out to disengage the battery and protect the wiring from damage due to accidental shorts. The Optacon will not run from a battery if the circuit breaker is not pushed in (but should run when the Optacon is connected to a charger). To engage the circuit breaker, push firmly. It should then remain engaged.

The fingerplate of the tactile array is grooved at the end to assist the reader in positioning his finger correctly. The tactile array is a little over one inch long and a half inch wide. The left hand should rest on the shelf with the left index finger flat on the fingerplate. The tip of the finger should be just able to feel the groove at the end of the fingerplate. The area of the finger which is involved in sensing the vibratory image is much larger than that involved in reading braille, and the reader must develop an ability to perceive an image which extends below the first knuckle of the finger. The finger should not arch nor curve to "braille" the character.

The TSI Stage One Teacher's Manual outlines an equipment check which should be completed before each instructional session. The student should check that lights in the rows and columns are appearing on the visual display, and also that the corresponding pins are vibrating on the tactile array, as the presence of a light does not guarantee that the pin is also vibrating.

The use of the tracking board should be explained to the student, who can then select a page from the TSI Stage One Manual and practice adjustments of the magnification and threshold controls and movements of the camera. Each student can then demonstrate knowledge of the equipment by introducing the equipment to another student who is under blindfold.

Some questions are frequently asked by students during the introduction of the equipment:

Can the battery be overcharged? The battery cannot be overcharged and the reader should form the habit of charging the battery overnight, every night. Although the battery charger is used during periods of instruction, from time to time the Optacon should be used without the battery charger, as sometimes a faulty battery is only detected under this condition. Continuous use of the charger during operation may delay repair until extensive damage has occurred.

Is there a limit on the size of the print which can be read? The Optacon can be used to read print sized from about 6 point to 20 point.

Won't very young children easily damage the equipment? The Optacon will withstand the usual handling by children. However, the tactile array is the most delicate part of the Optacon, and the most difficult to repair. It should be protected from jolts and from materials that may fall into the holes of the fingerplate. In particular, be sure that the finger used for reading is clean and free from lotion or hand cream.

REFERENCES:

Telesensory Systems, Inc. Optacon Instruction Manual. Palo Alto, California: Author, 1973.

Telesensory Systems, Inc. Optacon Training Manual, Stage I, Grapheme Recognition, R17464-A. Palo Alto, California: Author, 1973.

Telesensory Systems, Inc. Optacon Training Manual, Stage I, Teacher's Edition, R17464-A. Palo Alto, California: Author, 1973.

1.2

The lack of access to printed materials has been a primary problem for blind persons in all areas of education, vocation and recreation. Vocationally, communication between employer, employee and customer, or client, is ordinarily printed. Educationally, more and more courses are involved with independent reading whether at the college level or at lower levels. In many classrooms, the concept of a single textbook has been abandoned, and is replaced with "discovery" types of learning through investigation of many publications. The extensive library system and informational retrieval systems in the nation have developed into a sophisticated delivery system of printed materials for the sighted which is unavailable to the blind without intermediate translation, either to tapes, braille or aural reading through a sighted reader. While advancements in recording techniques and braille duplicating technology have eased the problem somewhat, it is obvious that the most efficient attack on the problem will be technology which will utilize the existing delivery systems developed

for sighted readers.

For at least fifty years, there have been attempts to produce a reading machine for the blind which could supplement the existing, limited modes of access to the world of print which are available to blind persons. The Optaphone, which was produced in 1912, has been followed by the Visatoner and, more recently, the Stereotoner. These machines produce a tonal, auditory output which not only has been difficult to learn, but limits the type fonts and spatial formats of material which can be read. Another instrument, the Transicon, utilizes a computer terminal, automatically scanning the print and producing output in braille or in voice simulation (spelling or words). This instrument is also limited, however, in the type styles which can be read. Disadvantages also include cost of operating the system and loss of confidentiality of material which is processed through the computer.

After a series of experiments which affirmed that tactile lettershapes could be recognized with efficiency, Dr. John G. Linvill, Chairman of the Electrical Engineering Department, Stanford University, and Dr. James C. Bliss, formerly Associate Professor of Electrical Engineering at Stanford University and Head of the Bioinformation Systems Group at Stanford Research Institute, developed the Optacon at Stanford, primarily under grants from the U.S. Office of Education.

When the present Optacon was ready for commercial production in 1971, Telesensory Systems, Inc. was formed, and Dr. Bliss became President.

Research and evaluation studies which have been conducted by American Foundation for the Blind, American Institutes for Research, and in England, Sweden and Italy have demonstrated the utility of the Optacon as a supplement to other modes of reading for the blind. As such, instruction in reading print with the Optacon should be a part of the total curriculum for developing communication skills of blind children.

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Linvill, John G. Research and Development of Tactile Facsimile Reading Aid for the Blind. Final Report. U.S.O.E., BEH, Project No. 142112, Grant No. OEG-0-9-07112-2995. March, 1973.

Taenzer, J.C. An Information Processing Model for Visual and Tactile Reading. Perception, 1972, 1.

Weihl, C. The Optacon Reading Program at the Monroe Public School. New Outlook for the Blind, 1971, 65 (5).

The sighted student who is preparing to teach reading with the Optacon to blind children need not be able to read tactually, but should have enough familiarity with the images presented on the tactile array to detect trouble with the equipment, and will need to be provided with hands-on experience to develop this familiarity. In addition, experience with interpreting the moving tactual images helps the student become aware of the perceptual and cognitive skills which are involved in reading text presented one letter at a time in a "Times-Square" moving display.

The student must, however, develop personal skills in tracking with the camera and adjusting the controls of the equipment. The camera may be grasped any way that is comfortable to the reader. A slight pressure on the back end of the probe will keep the rollers firmly on the paper. If the index finger is extended forward on the top of the camera, the camera should not be tipped forward, and the finger must not inadvertently move the magnification button from its setting.

In the beginning, the camera is moved from left to right across the line, back to the beginning of the same line from right to left, and then moved down to the next line. More experienced readers change lines with a diagonal return of the camera.

The rollers aid in keeping the camera straight across the line. However, the arm and hand motion of the reader is very important. The elbow and wrist should be slightly raised from the table to prevent an arc-motion

which will cause the camera to skew. The student who practices with the proper hand and arm motion will find that if the table is too high, his shoulder muscles will quickly tire and become cramped. It is important when teaching a child to read with the Optacon that the equipment be arranged comfortably on furniture of the appropriate size for the child.

The left finger should rest lightly on the fingerplate as the most information is received through the making and breaking of contact with the skin. The Optacon should be placed on the table in a position to enable the reader to rest his forearm on the table.

As the camera is moved across the line, it should be positioned with respect to the line for the letters to travel across the tactile display as if they were sitting on a shelf about one-fourth from the bottom to allow for the presentation of descenders in some letters. The appropriate sized upper case letter should extend over the top 19 rows of the display, and it has been demonstrated that the fastest reading is accomplished with letters of this size.

The sighted student will use the position and identification of graphemes presented on the visual display to guide the movements of the camera, and should practice tracking first with the tracking aid, using the TSI Training manuals. When his skills have been developed fairly well, he should practice free tracking on the same materials, and finally on a variety of other books, magazines, etc., until he is completely accurate in presenting the material.

REFERENCES:

Telesensory Systems, Inc. Optacon Training: Teaching Guidelines. Palo Alto, California: Author, 1974.

1.4

The Master-Monitor Cable enables two or three Optacons to be connected so that all the tactile stimulator arrays present the image from one of the cameras. This cable makes it possible for a teacher to work with more than one student at a time, or for a teacher who is blind to work with a student.

The Automatic Page Scanner automatically scans the page with the attached camera at variable speeds up to 100 words per minute, taking the tracking task away, and permitting the student to concentrate on decoding. In addition, the Automatic Page Scanner tracks across the line perfectly, and presents perfect letters. This instrument has proven to be invaluable in enabling the readers to develop increased speed in reading. The students should have ample opportunity to become thoroughly familiar with the controls of the machine and to practice using it in a simulated teaching situation.

The Calculator Lens Module F2B differs from the normal lens in three ways: the focus plane is in a different position, there are no lights, and the spectral sensitivity of the optics is different. The Optacon model which usually needed to read the calculator is called an R1C, and can be recognized by the blue front. While both Optacon models R1B (gold front) and R1C (blue front) can read some calculators, the R1C model can read a wider range of calculators because of its

greater sensitivity.

The Cathode Ray Tube (CRT) Lens Module, F1A, allows the user to read many CRT displays directly. It is used primarily by computer programmers and by those who require the CRT for information retrieval.

The Magnifier Lens Module, F4A, increases the magnitude of the image about 40% over the normal lens, thus enabling the user to read smaller print than that possible with the normal lens.

The Typewriter Lens Module, F3A, is an Optacon accessory which allows the Optacon user to inspect and read the character which has just been typed, make typing corrections, locate typing position when interrupted, and to fill in information on pre-printed forms.

REFERENCES:

Telesensory Systems, Inc. Optacon Training: Teaching Guidelines. Palo Alto, California: Author, 1974.

2.0 INSTRUCTIONAL STRATEGIES

OBJECTIVES:

2.1 Workshop Director will present Information Theory concepts, including definition of critical features.
- 2.11 Student will analyze letters of the alphabet, and identify critical features.
- 2.12 Student #1 will teach Student #2, who is under blindfold, to identify capital letters and lower case letters, using Lessons Two and Three, Ten and Eleven of TSI Stage One Manual.
- 2.13 Student #2 will teach Student #1, who is under blindfold, to identify capital letters and lower case letters, using Lessons Four, Five, Twelve and Thirteen of TSI Stage One Manual.

2.2 Workshop Director will discuss redundancy in language and instructional strategies to develop language skills necessary for speed building.
- 2.21 Students will review letter probabilities in English Language.
- 2.22 Students will practice Shannon's "Guessing Game".
- 2.23 Students will practice "Cloze Procedure".

2.3 Workshop Director will demonstrate procedures for developing curriculum through Component Analysis.
- 2.31 Students, in groups, will devise Component Analyses of task: Read One-line Sentence with Optacon.
- 2.32 Students will translate Component Analyses into sequential instructional objectives.

2.4 Workshop Director will review common problems outlined in TSI Teaching Guidelines.

2.5 Workshop Director will discuss use of Component Analysis and Sequential Instructional Objectives for problem solving.
- 2.51 Students will map strategy for analyzing and remediating given problems, using Component Analysis, etc.

Since reading print with the Optacon involves the perception of one letter at a time and integration of the letters into words, and research has revealed that the perceptual unit in reading braille is a single cell, it would appear that both modes of reading require similar perceptual and cognitive skills, the differences being mainly in the informational value of the unit. It has been demonstrated that speed and comprehension of reading braille is, in part, a function of accuracy of character recognition, and some research has also demonstrated a like relationship for reading with the Optacon. The student must be prepared to teach children to discriminate, recognize and identify the upper case and lower case alphabets in the various type styles which are used in printed books. The reader must, then, develop "critical feature" lists for letters which will enable him to categorize these letters into the proper classes, regardless of size, serifs, or other embellishments which are present in the graphic representation. A teacher must present the letters to a child with consistent, efficient emphasis upon the critical features, or must assist the child to intuitively discover the critical features.

Previous Optacon training can be described as a "direct method". The learner is made to establish direct associations between tactile images and verbal identifications, and the teacher serves to provide feedback and reward for correct identification. Each Optacon letter is presented

repeatedly, and the learner is first told what the letter is by the teacher, and then says the name as the letter is repeated.

Another method can be called the "insight" method. In this, the learner is systematically taught to develop a strategy for discriminating, recognizing and identifying the tactile image. The teacher stresses the features in the tactile image which contain the most information, and instructs the student to direct his attention to those features.

It has been demonstrated that readers have experienced considerable difficulty in transferring from the simple Gothic print of the training materials to the reading of more complex type styles. It is conceivable that earlier practice with individual letters in other type styles may serve to establish the critical features, and help to overcome this difficulty. To prepare for either teaching strategy, the student must understand the concept of "critical feature" and be able to describe letters in terms of their critical features.

An understanding of the concepts and the language of Information Theory, also known as Communication Theory, will aid the student in identifying the critical features of graphemes, and in describing the letters.

The definition of "Information" is: that which reduces uncertainty. The unit of measurement is a "bit" (for binary digit) which is the amount of information required to reduce uncertainty by one-half. The number of bits of information is equivalent to the number of yes-no questions which must be asked in order to specify one alternative out of many possible ones. This concept can be demonstrated by playing a "20 Question" type

of game with the student trying to guess a letter of the alphabet which has been chosen by the instructor. As each letter of the alphabet has an equal probability of occurrence, there will be 26 alternatives, or an uncertainty of 26. Between four and five yes-no questions will reduce this undertainty (1/2 - 1/4 - 1/8 - 1/16 - 1/32), and there are, therefore, 4+ bits of information in each letter.

A single feature of the letter may contain a different number of bits. For example, the left vertical stroke line of the upper case H eliminates the alternatives C, G, J, O, Q, S, T, U, V, W, X, Y, Z, leaving only 13 alternatives, and therefore this feature contains one bit of information. The single horizontal stroke in the center of the H eliminates all other letters, and contains 3+ bits of information.

Two other concepts from Information Theory are pertinent. Extraneous signals, or signals which may confuse the message as it is communicated, reduce the amount of information received at one time and are called "noise". Signals that convey no information, difficult to read type fonts, poor contrast in materials, and any part that the receiver lacks the skill to comprehend, will create noise. Distinctive, or critical features convey information. "Redundancy" exists whenever information is duplicated by more than one source, or whenever the same alternatives can be eliminated in more than one way.

In the above example, the vertical stroke to the right of the upper case H can be viewed either as "redundancy" or "noise".

When identifying the critical features of letters which are presented on the tactile array, more than one condition should be considered. If the camera is positioned accurately, or if letters are being scanned automatically by the APS, the letters can be analyzed as they appear in print. However, some consideration should be given to changes in the appearance of letters if, for instance, the camera were skewed or the letters were printed in irregular type face. For example, in the printed letter A, the slant line at the left conveys information. However, if the camera were skewed, the same slant line would appear on the left of the upper case H (H); in which case the point at the top of the A would convey more information.

Students who are preparing to teaching reading with the Optacon should analyze upper and lower case letters of the alphabet and develop a critical feature list for each letter which should be stated in consistent terms of ascenders, descenders, symmetry, horizontals, verticals, slants, etc. Strategies for teaching these features and letters should then be considered.

Features should be taught sequentially through three levels: discrimination, recognition and identification, defined as:

Discrimination: to separate one from another by discerning the minute differences.

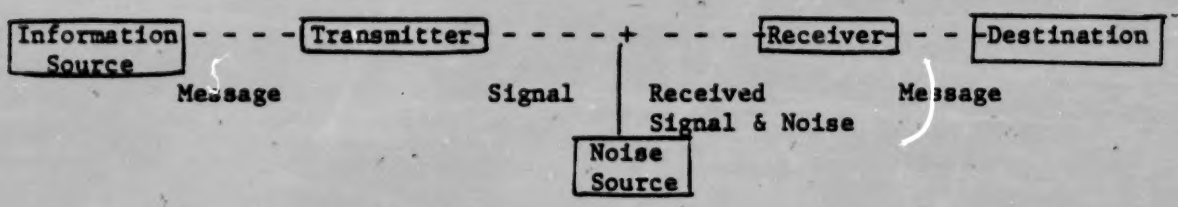
Recognition: to perceive to be a thing previously known (matching).

Identification: to make to be the same; to consider as the same; to classify.

The analysis should begin with the upper case letters, as it appears that the critical features contained in upper case letters are most distinct and easy to identify. Most students have not previously learned to examine different type styles critically, and several examples of sans-serif type, and types with increasingly complex serifs are helpful at this point. The student should consider that the tactual reader will perceive the image only if it is moving across his finger. If the camera is held static on a letter, it will be perceived by the reader only as diffused vibration. Each letter "comes in at the right, and goes off at the left" across the index finger of the reader, and the critical features must be discriminated and recognized in this order. TSI will supply sheets of raised letters which are of the same approximate size as those presented on the tactile array. Some teachers have found these helpful for pre-reading exercises, especially for older children. However, some teachers have also found that children who have been unable to identify the raised letters have easily learned to identify the moving letters on the tactile array.

The objectives for the experience of students teaching other students who are under blindfold, are two-fold. The student who is teaching will develop the ability to describe letters in terms of their critical features and to adjust the magnification and threshold controls to maximize discrimination of the critical features. The student who is learning will develop personal insight into the task of sensing and perceiving the moving tactile image.

Reading is an act of communication between an author and a reader. As in all acts of communication, the reader must make an active contribution if he is to acquire the available information transmitted by the author. We can consider a human being as an information-handling channel or device having certain built-in limitations and properties. An analysis of the reading process based upon Shannon's Communication Theory gives direction to a consideration of the cognitive processes involved. Shannon postulated communication as a system which can be represented symbolically in the following model:



In reading tactually, the Information Source is the author who uses the written word as the transmitter of his message. The signal (braille or print) is received through the nerve endings of the finger (Receiver). The message reaches its destination when it is translated into meaning by the reader. There may be some loss of communication between the author and reader through the translation of a mental message into written words, through limitations in the channel capacity, or through limitations of the reader in assigning meaning to received words.

"Channel Capacity" is defined as the limit or amount of information that can pass through the channel. Extensive research has demonstrated the

capacity of the tactual channel to be one letterspace at a time. Experiments with presentation of a wider field, that is presentation of letters to two fingers at a time or two letters to a single finger, have indicated no improvement in speed of reading with an Optacon.

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Reading is a process of selecting partial cues and anticipating the message as one reads. In this partial perception of cues, the reader uses three kinds of language information: grapho-phonic information, syntactic information, and semantic information. Grapho-phonic information is that information conveyed by the graphic shapes, sound patterns of the language, and the relationship between the graphic shapes and sound patterns. Character recognition, then, is essential for tactual reading. However, while some redundancy exists in orthographic information, much more exists through the constraints put upon the order of letters and words which are defined by the parameters of the syntax of the language, the semantics, and the spelling patterns of words in the language. It has been estimated that English is 75% redundant. That is, in a string of English letters in text, 75% fewer guesses would be needed on the average to guess the next letter in the string than would be needed if the letter string was completely random.

Alternatives of letter occurrences are reduced because they are not equally probable. Several studies have been conducted to identify the frequencies of occurrence of letters in various positions in words, and rank-order lists have been published (See Appendix). Words, as well as letters, contain this source of redundancy.

Another source of redundancy exists through the spelling patterns of the language. For example, "p" does not usually follow "t". Certain patterns, e.g., VC, CVC, exist within syllables.

The syntax of the language contributes redundancy. Knowledge of the structure will contribute clues concerning the parts of speech, nouns, verbs, etc., which are needed as the thought in a sentence progresses. The order in which words may appear in the English language is one of the chief signals of meaning.

Semantics, the meanings of expected words, contribute redundancy. Familiarity with words, idioms, cliches and grammar enables the reader to fill in missing or incorrectly identified letters. Less orthographic information is needed if letters do not appear in isolation. If the reader demands too much information from the graphemic symbols, he will often be unable to read fast enough to overcome memory limitations and read for sense. The reader needs to have learned the rules of the language to effectively increase speed of reading. The student who is preparing to teach reading with the Optacon should understand these sources of redundancy and their contribution to successful reading with the Optacon, since there exists no published curriculum or reading system for teaching this skill.

The Workshop Director can demonstrate to the students that they can utilize the redundancy in the language, and, also, identify the existence

of the most information in words and continuous text by playing, with the students, some adaptations of Shannon's "Guessing Game Experiments". (See Appendix):

"Select a short passage unfamiliar to the person who is to do the predicting. He is then asked to guess the first letter in the passage. If the guess is correct he is so informed, and proceeds to guess the second letter. If not, he is told the correct first letter and proceeds to his next guess. This is continued through the text. As the experiment progresses, the subject writes down the correct text up to the current point for use in predicting future letters. The result of a typical experiment of this type is given below. Spaces were included as an additional letter, making a 27 letter alphabet. The first line is the original text; the second line contains a dash for each letter correctly guessed. In the case of incorrect guesses the correct letter is copied in the second line.

(1) THE ROOM WAS NOT VERY LIGHT A SMALL OBLONG
(2) ---ROO------NOT-V-----I------SM----OBL---

(1) READING LAMP ON THE DESK SHED GLOW ON
(2) REA---------O------D---SHED-GLO--O-

(1) POLISHED WOOD BUT LESS ON THE SHABBY RED CARPET
(2) P-L-S------O--BU--L-S--O------SH-----RE--C-----

An extension of the above experiment yields further information concerning the predictability of English. As before, the subject knows the text up to the current point and is asked to guess the next letter. If he is wrong, he is told so and asked to guess again. This is continued until he finds the correct letter. A typical result with this experiment is shown below. The first line is the original text and the numbers in the second line indicate the guess at which the correct letter was obtained".

(1) T H E R E I S N O R E V E R S E O N A M O T O R C Y C L E
(2) 1 1 1 2 1 1 2 1 1 2 1 1 15 1 17 1 1 1 2 1 3 2 1 1 2 2 7 1 1 1 1 4 1 1 1 1

(1) F R I E N D O F M I N E F O U N D T H I S O U T
(2) 8 6 1 3 1 1 1 1 1 1 1 1 1 1 1 6 2 1 1 1 1 1 1 2 1 1 1 1 1 1

(1) R A T H E R D R A M A T I C A L L Y T H E O T H E R D A Y
(2) 4 1 1 1 1 1 1 1 15 1 1 1 1 1 1 1 1 1 1 1 1 1 1 6 1 1 1 1 1 1 1 1 1 1 1 1 1

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As a second demonstration of the utilization of the redundancy in the language contributed through syntax and semantics, students may practice an exercise with the "Cloze Procedures". In addition to demonstrating the importance of appropriate anticipation skills to the students, this exercise suggests instructional methods and materials which can be utilized to develop skill in reading with the Optacon.

1. Prepare passage, every fifth word deleted and replaced with blank of standard length. Also passage with no deletions should be prepared.
2. Student reads entire passage with words deleted.
3. Students suggest words to put in blanks, giving reasons for choices.
4. Students compare corrected passage with original passage without deleted words.
5. Students and teacher discuss whether meaning is affected by change in words.
6. Teacher points out how words in immediate environment cue readers, position of word limits choice, and redundancy in sentence gives clues.

"The preceding instructional procedure can be varied by the use of different types of cloze passages to foucs on different aspects of reading instruction. Some examples follow.

Prepare cloze passages deleting certain lexical items (nouns, verbs, adjectives) to foucs instruction on the syntactic constraints of the language.

Prepare cloze passage deliting parts of words (for instance, delete all of the word except for initial and final phoneme, inflectional ending, or prefix) to focus instruction on word analysis strategies.

Prepare cloze passages with only the first or last word of a sentence deleted as another means of focusing instruction on the syntactic constraints of the language.

Prepare cloze passages deleting items for which students must supply synonyms to focus instruction on vocabulary (meaning) development.

Prepare cloze passages over different content areas or authors to focus instruction on differences in language structure or style.

Prepare cloze passages in which items containing certain phonemegrapheme correspondences are deleted (for instance, all words deleted contain the short a vowel sound, consonant cluster or, whatever) to focus instruction on this particular type of word analysis strategy"*

An important skill which is necessary for tactual reading is the ability to store information in short term memory while processing new information. Nolan has demonstrated that while the time required for the identification of whole words and phrases is as brief as the time required to identify a single letter for the visual reader, the same is not true for the tactual reader. He wrote: "The process of word recognition appears to be a sequential integrative one in which word recognition is the result of the accumulation of information over a temporal interval".

The reader who is limited in perceptual input must learn to formulate rules for, or develop his skills of organizing or grouping the information into familiar units or chunks. Just as a Morse Code operator learns to increase his speed by first perceiving dots and dashes, then letters, then words and phrases, the reader learns to increase the bits of information per chunk by "recoding" individual letters into chunks by grouping input, applying new names to the groups, and then remembering the new names. The same process has been discussed as it relates to the

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* Bortnik, Robert & Lopardo, G.S. "An Instructional Application of the Cloze Procedure". Journal of Reading. January, 1973. pp. 296-300. Reprinted with permission of Robert Bortnik & Genevieve Lopardo and the International Reading Association.

reading of braille and recommendations have been made for enlarging the braile cell or creating new contractions which will contain more information per cell.

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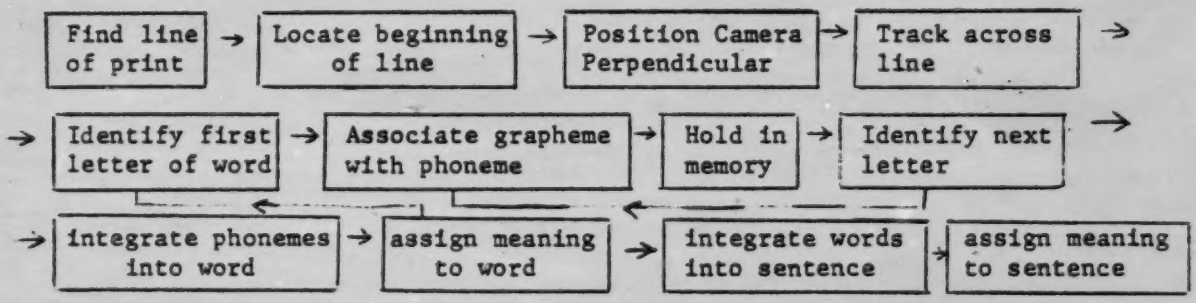
Many of the skills which must be developed for the reading of print with the Optacon are also essential for the reading of braille. There appear to be, however, certain motor, perceptual and cognitive skills which are specific to reading with the Optacon. In addition, few curriculum materials have been published for the use of teachers of tactual reading above the pre-reading level. The prospective teacher of Optacon reading must develop some competencies in curriculum development, production of training materials, and diagnosis and remediation of specific problems. After having identified the skills which are involved in Optacon reading through the previous activities, the student must order these skills as objectives to be attained sequentially, for the learner to move smoothly through them to proficiency in reading. Detailed analysis of the task will reveal components and prerequisite behaviors. Resnick has developed a procedure for this analysis.

The first step in performing a behavioral analysis is to describe the steps which are involved in the skilled performance of the task, in a temporal sequence. It is useful, as a beginning, for students to list these steps in as much detail as possible although, as the analysis progresses, overlaps will be revealed and/or multiple steps may be subsumed under more general headings.

A component analysis of a general terminal task "Read with the Optacon" will involve so many factors, such as positioning the book, finding the page, understanding the format, etc., that the exercise will

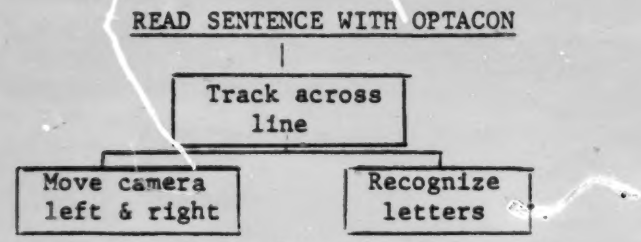
be more manageable by the students if parameters are set for the terminal task which is to be analyzed. For example, assuming that the equipment has been set up and checked out, and that the reader has been given a single sheet of paper, right side up, with a one line sentence printed upon it, the terminal task to be analyzed may be: "Read Sentence with Optacon". The students write this task at the top of the page, and proceed at the next level below to describe the steps which must be made to accomplish this task, stating each step behaviorally and indicating their temporosity with arrows between the boxes. For example:

READ SENTENCE WITH OPTACON



These behaviors are components of the terminal behavior. It is hypothesized that the skilled person actually performs these steps (although sometimes very quickly and covertly). Sometimes there are "loops" in the chain, indicating that it is necessary to recycle through some of the steps several times to complete the task.

Once the components are identified, a second stage of analysis begins. Each component is considered separately, in isolation from all the rest. The question is asked: "What must the person be able to do, or to know, to perform this behavior?" Here, the aim is to specify prerequisites to each behavior. Prerequisite(s) are listed at the next level below the components. For example:



Continuing the analysis, identified prerequisites are themselves further analyzed to determine still simpler behaviors. The process is continued until a level is reached at which the assumption can be made that the learner enters the sequence.

Sometimes a single behavior is prerequisite to more than one higher-level behavior. Conversely, a single behavior can have more than one prerequisite. The interrelationships revealed by these analyses form the basis for sequencing objectives within the curriculum. (See Appendix for one example of a simplified analysis chart).

The completed chart is then read from the bottom up, and across the levels. To each behavior, the student assigns an intructional objective. These behaviorally stated instructional objectives are listed sequentially,

the result being a curriculum outline which the teacher can utilize for teaching children of all ages and abilities.

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2.4

The Teaching Guidelines which are available from TSI have been developed, in the main, for teachers by experienced teachers of Optacon reading. Many of the problems and possible solutions which are discussed have been found to be common to most adult learners. A review of this section is helpful to prospective teachers who will be required to prevent or remediate like problems.

The Component Analysis and sequentially ordered listing of instructional objectives which have been developed by the students can be used as a "road map" for the diagnosis and remediation of learning problems. It is frequently defeating to a child to be required to practice a skill at which he is continuously unsuccessful because he has not mastered a prerequisite skill. For example with letter confusions, the learner may be drilled on material designed to develop discrimination of critical features when the prerequisite skill which he lacks is the association of a letter name or phoneme to a grapheme image. A specific problem may be better remediated by an assessment of the learner's mastery of the prerequisite skills. Practice on materials designed to develop a lower level skill may solve the problem, and enable the learner to move ahead.

Using the problems presented in the TSI Teaching Guidelines, or simulated problems which are suggested by the Workshop Director, the students, in groups or individually, should design strategies for diagnosis and possible remediation.

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3.0 ASSESSMENT

OBJECTIVES:

3.1 Workshop Director will discuss research concerning characteristics of successful Optacon readers.
- 3.11 Students will identify possible variables which may affect success in reading with Optacon.
- 3.12 Students will explore, through discussion, applicability of assessment instruments which have been developed for visual readers.

3.2 Workshop Director will demonstrate use of Component Analysis to assess level of student.

3.1

Reports of the several evaluation studies which have been conducted with the Optacon to date have suggested that reading print with an Optacon is perhaps not appropriate for all blind children. These studies, however, have been conducted with small numbers of subjects and leave many unanswered questions concerning the causes for the apparent failure of some persons to learn. Relationships between certain psychological variables and success in reading have been investigated, however in the present state of the art, little definitive data has been published which could give guidance to the field. There appears to be relatively little difference between the knowledge of projective assessment measures for learning to read with the Optacon and learning to read with Braille.

At the present time Nolan and Morris' Roughness Discrimination Test is the only instrument which has been developed uniquely for blind children to predict reading achievement, although some other investigative works have been reported in literature.

Because of economic considerations, there has been considerable pressure from funding agencies for adequate screening of prospective trainees. Batteries of instruments, published standardized intelligence tests, research-developed tests of tactual discrimination, adapted tests of short-term memory for letters, and personality factors have been suggested and discarded. At the present time, it appears that the only valid screening procedure is to try the learner for a short time on the Optacon and rather subjectively make a prediction of success or failure in the future.

In 1972, the Center for Rehabilitation in Heidelberg, Germany, reported that the important factors in achieving success with the Optacon appeared to be: motivation, time spent, intelligence, age, and correct technique.

In 1973, Tobin, University of Birmingham, England, completed a one year study, in part to identify the characteristics that were associated with successful learning. The study involved 30 teenage and adult subjects who completed an initial training of 10 hours, ten of whom received follow-up training of 30-60 hours. Ten Optacons were utilized in the study. Average Optacon reading speed, at the end of the ten hour period, was 6.6 wpm. Relationships between sex, age, degree of residual vision, age of learning braille, previous visual experience, speed of reading braille, short-term memory, two-point threshold, certain personality factors, and speed of reading braille were tested. Of these, only age, short-term

memory, speed of reading oraille, and two-point threshold proved significantly related.

In 1974, the American Institute for Research reported a two year study of a stratified sample of students, grade 4-12, in selected residential and day school programs in the United States. Relationships between measures of intelligence, speed of reading braille, comprehension, tactile ability, English spelling ability, attitudes toward self, attitudes toward education, and speed and accuracy of Optacon reading, variety of usage, and attitudes toward Optacon, self, and education were tested. Of these, significant relationships were revealed between: I.Q., tactile ability, accuracy of reading braille and combined speed and accuracy of reading with the Optacon, grade, age, sex, spelling, attitudes toward education and accuracy of reading with the Optacon. No significant relationship was reported between speed of reading braille and speed or accuracy of reading with the Optacon; nor between measures of self-concept and speed or accuracy of reading with the Optacon, nor of variety of uses with Optacon.

Schoof analyzed relationships between age, sex, age of onset of blindness and speed of reading with braille and a combined score on speed and accuracy of reading with the Optacon. He reported an important, significant, effect of age on the reading speed achieved by 58 TSI students, aged 10 years and over, at the end of a 50-hour training course, with younger learners developing the most speed.

Marmolin and Nilsson, from results of a study of Optacon readers conducted by the Pedagogical Institute, Uppsala Normal School, Sweden, stressed that, research emphasis should be placed upon training methods rather than upon establishing screening procedures.

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It appears, then, that assessment of learners' success, as with most other achievement factors in blind children, can be most appropriately accomplished through the use of criterion related tests. For measurement of speed and comprehension of learners who have mastered recognition of characters, and have proceeded into various continuous text readings, graded reading paragraphs which have been published for sighted readers can be produced in clear printing which will reduce undue adjustments of magnification and threshold while reading.

For assessment of progress in mastery of the prerequisite skills, again the list of sequential instructional objectives which have been developed by the students will prove to be useful. Students should be encouraged to develop for each instructional objective, a very specific demonstration for which they can design materials. For example, if the instructional objective is stated: "Given series of critical features, all of which are different, and one example, child will pick out from

series the one which matches the example", the student should prepare printed sheets with several series of horizontals, verticals, open and closed shapes, etc., to assess mastery of this objective. The prospective teacher can use these materials not only for assessing the entering behaviors of children, some of whom will be previous braille readers and some of whom will be beginning readers, but for assessing and charting progress as the child is learning.

4.0 INSTRUCTIONAL MATERIALS

OBJECTIVES:

4.1 Workshop Director will present an overview of training materials from TSI, AIR, and San Diego.
- 4.11 Student will investigate materials.
- 4.12 Student will practice free tracking, and adjusting threshold and magnification on materials.

4.2 Workshop Director will discuss use of Component Analysis as guide to materials development.
- 4.21 Student will prepare materials to teach to sequential instructions objectives.

4.3 Workshop Director will present criteria for evaluating commercial materials.
- 4.31 Student will investigate commercial materials using Optacon, free tracking and adjusting for varying print styles.
- 4.32 Student will prepare annotated bibliography of commercial materials.

4.1

Instructional materials for the use of teachers of reading with the Optacon are now available from Telesensory Systems, Inc., American Institute for Research, and the San Diego City Schools.

The San Diego City Schools, under a Title VI grant, conducted one of the first systematically developed Optacon Projects, and as a result, have developed some materials for teaching primary and elementary school children. The primary materials include some pre-reading activities and printed materials which can be utilized independently, or in conjunction

with other reading instruction involving the Harper and Row Basal Reading Series. A teacher's manual accompanies the elementary student's practice manual. It is suggested that the learner do no tracking until he is familiar with more than half of the letters of the alphabet. The alphabet, for presentation, is divided into four letter groups. Simple words and short sentences are introduced within each letter group. Criterion exercises are included for each lesson. Lessons progress in order: 1) non-meaningful shapes and symbols; 2) upper case letters O I B S T G, E U D F N B; 3) lower case letters o i b s t g, e u d f n b...; 4) reading rate building exercises; and 5) exercises for reading complex type styles.

The American Institutes for Research developed materials to be used in their evaluation study with elementary and secondary children which were evaluated, revised, and are available now commercially. Materials for primary readers were developed at the end of the project. In the manuals, the earliest letters which are introduced are those used most in English. New letters are introduced, and interspersed with practice of letters which have been previously learned. Criterion exercises are included as are remedial and supplementary exercises. Order of presentation is: 1) numbers; 2) upper case letters A T R E; 3) lower case letters a t r e; 4) upper case letters I H O S; 5) lower case letters i h o s...

The Telesensory Systems, Inc., instructional materials were developed, in the main, through an iterative process utilizing feedback from testing with the first Optacon learners at colleges and at the Seeing Eye training center. Presently, the fourth revision of the materials are available. (See Appendix)

While TSI materials have generally been used for training teachers, prospective teachers should become familiar with the sequences and formats of all of the various training materials. Experience has shown, however, that all presently available materials are, in the main, useful only for instruction in the identification of letters of the alphabet and certain minimal reading skills. The teacher of children of all ages will find it necessary to select, adapt, or create additional materials for the development of reading skills from beginning reading to adult levels.

4.2

Students, with guidance from the Workshop Director, should have some experience in developing, preparing, and/or describing suitable methods and materials for meeting the instructional objectives which they have developed. Appropriate lesson plans with examples of materials can be developed by each student for use in instruction toward randomly chosen instructional objectives.

Prospective teachers will need, in addition to published curriculum materials, a library of books in appropriate type styles at various reading levels to be used by learners for "real-life" practice. It is important that the students develop competencies in evaluating commercial materials. Students should have access during the workshop to many of the commercial reading books and workbooks, investigate these materials visually and with the Optacon, evaluate each and, as a group, prepare an annotated bibliography for future personal use and dissemination. It is suggested that, for consistency of reporting, students judge the books in three levels of difficulty - easy, medium, and hard - in three different areas - print style, format, and reading level. A book is usually not consistent in difficulty in all three areas. One with easy, short selections may be put together in a confusing and inconsistent manner. Each book should be judged in each area. The levels are defined as follows:

Print: Print varies in difficulty for the Optacon reader according to the number of complications on the letter itself (serifs, curlicues, varying stroke widths), the size of the letter, and the amount of contrast between the letter and the background.

A. Easy: sans-serif; even, narrow stroke widths; medium to large size.

B. Medium: simple serifs, uneven stroke widths; medium to large size.

C. Hard: many serifs; extreme variation in stroke widths; small size.

Format: Book layouts vary in difficulty according to the amount of unused space on the page, the page numbering system, the number of type styles, the number and placement of pictures, and the variety of written material.

A. Easy: little empty space; consistent written material (all essays, all quotes); consistent placement on page; consistent, easy print style.

B. Medium: moderate use of pictures or different types of materials or print styles.

C. Hard: inconsistent placement of material on page; use of many different types of materials or print styles.

Level: Books vary according to literary difficulty (reading level, and sophistication of content) and length of selection.

A. Easy: short selections, and/or simple syntax, and/or simple themes.

B. Medium: longer selections (1-4); and/or more complicated syntax; and/or more adult themes.

C. Hard: novels, or long selections; sophisticated, complicated syntax; and/or adult themes.

Bibliographies which have been prepared through activities in previous workshops may be found in the Appendix.

As students practice tracking and equipment adjustment with varied materials, they not only develop competencies in evaluating materials, but

develop self-confidence and personal competencies with the Optacon. A printed sheet, such as the Materials Adjustment Sheet which is prepared by TSI (See Appendix), which contains short selections in various sizes and print styles may serve as the final evaluation. The Workshop Director may observe and evaluate each student's tracking and skill with the Optacon adjustments as he practices with this sheet.

5.0 PSYCHOEDUCATIONAL FACTORS

OBJECTIVE:

5.1 Workshop Director will discuss vocational, educational and sociological considerations relating to the Optacon.
5.11 Students will discuss possible effect of these factors upon motivation for learning and implication for development of instructional strategies.

5.1

A study conducted by the American Foundation for the Blind indicated that the occupations of users of the Optacon included, in rank order: Computer Professionals, Students, Social Workers and Rehabilitation Counselors, Business and Administrative Personnel, Miscellaneous Professions, Engineering and Technical Occupations, College Professors, Attorneys, and Clerical and Other Occupations. Application of the basic Optacon and accessories for reading tasks other than normal reading have proven to significantly extend the capabilities of a blind person and to open up new vocational opportunities. For example, the cathode ray tube, or television tube, is becoming an increasingly popular information display device, and is employed in airline reservation offices, customer service centers, as well as computer centers. The capability of a blind person to read such terminals not only expands opportunity, but protects against obsolescence for computer programmers. The typewriter lens module enables the blind person to fill out pre-printed forms, make typing cor-

rections, and regain his place when interrupted. The Optacon and these accessories are helping to eliminate vocational barriers whenever independent access to print is important. New non-stereotyped vocational opportunities are being identified and many already-employed blind persons have been promoted beyond entry-level positions which frequently underutilize their talents as a result of becoming Optacon users.

In the AIR educational evaluation of the Optacon, there was almost unanimous response that students would choose to continue using the Optacon, if one were available to them. An analysis of the daily living routine of a normally seeing person reveals the extent to which reading pervades the entire life style. Blind students who have been involved in the AIR evaluation, and the Pennsylvania Optacon Project, who have learned to read independently with the Optacon, have reported the types of material chosen for independent reading, and the uses they have made of the Optacon in their daily living. Some of these uses include:

In School:

Student reports on newspaper readings which are assignments for social science class (6th grade)

Student uses Optacon in school library to locate material (9th grade)

Student uses Optacon for dictionary work (5th grade)

Student uses Optacon for wall charts, graphs and tables (10th grade)

Student reads science textbook, which is unavailable in braille (7th grade)

Student uses Optacon for Data Processing material (11th grade)

Student works in school radio club as a disc jockey and uses Optacon for reading lyrics, record jackets, etc. (11th grade)

Students read recipes, labels and cooking directions in home economics classes and at home (5th and 7th grades)

Recreation:

Student uses Optacon for independent fiction reading (4th grade)

Student reads music magazines and is trying music (11th grade)

Students read hobby magazines, e.g., Sporting News, Pennsylvania Game News, Current Science, Horoscope Magazine, Boys Life, U.F.O. Magazines, QST, Co-Ed Magazine

Students read knitting and crocheting instructions

Besides the Optacon, the methods of reading usually available to blind students are braille (such as that produced by the American Printing House and local volunteer transcriber groups), recordings (such as those produced by Recordings for the Blind and local volunteer groups), talking books (such as those produced by the Library of Congress), and paid or volunteer readers. Most educators and blind people feel that all of these reading methods are important, and that any one method should not be thought of as replacing or eliminating the others. The general opinion is that more reading methods are needed, not fewer. The typical sighted student studies from at least five textbooks a year, reads at least another five library books, and in addition reads many worksheets, lesson contracts, and other instructional materials. No matter how excellent the transcription services, it is extremely difficult, if not impossible, for braille and recorded media to provide blind students with equal access

to the printed information read by their sighted colleagues.

Even though the Optacon is not expected to eliminate the need for braille and recorded media, it is important to compare these reading methods on the basis of speed and cost in order to understand the most effective role for each. While the actual speed of reading with the Optacon alone is usually slower for most people than braille or recordings (but the Optacon together with a spoken work output accessory could be as fast or faster), the lead time required to have material transcribed from print to either braille or recorded form is a significant factor which should be included in the effective reading speed. When such lead times are taken into account, the Optacon becomes clearly the most effective alternative for many situations. For example, the requirement for advance decisions about books, papers, and articles to be used in a given course to permit time for transcription, would so restrict the flexibility of both student and teacher as to be impractical.

Although blind students seldom realize it, there are substantial additional costs involved in the preparation of instructional materials in braille or recorded form. Additional educational costs for a blind student in a public school, over and above the costs for a sighted student, are often more than $1,000 per year, not counting voluntary labor and the American Printing House Federal Quota. Moreover, when the student leaves school these services are often largely withdrawn, making it difficult for the blind person to function at the level at which he has been trained.

Table II gives a cost comparison among the various reading media used by blind students on a per book basis. This analysis shows that a typical transcribed book for the blind costs between $75 and $168 depending on whether any value is placed on volunteer labor. On this basis, the cost of an Optacon is roughly equivalent to from 17 to 39 transcribed books, or the reading consumption of a typical sighted student in less than three years.

REFERENCES:

Goldish, Louis H. and Taylor, Harry E. The Optacon: A Valuable Device for Blind Persons. The New Outlook for the Blind, 1974, 68, (2).

Moore, Mary W. 1974-75 Report of the Pennsylvania Optacon Project for Teaching Reading to Visually Handicapped Students. University of Pittsburgh, Pittsburgh, PA.

Table II

COSTS OF ALTERNATIVE READING MEDIA*

Medium	$ Cost/Book	No. Books Equivalent to Optacon Cost
Recordings for the Blind	160	18
Locally Produced Recorded Materials and Books Obtained Through Readers	85	34
"Commercial" Braille	100	29
"Volunteer" Braille (not including value of volunteer labor)	75	39
"Volumteer" Braille (including value of volunteer labor)	168	17

*Based on an analysis by Loren Schoof

Example breakdowns are as follows:

Recordings for the Blind

1. 1974 Book Value of RFB services and activities: $2.5 million
2. No. of books transcribed in 1974: 4500 Titles x 3.4 copies/title
3. (1) above divided by (2) above = $163.40

   OR 20 pages can be recorded in one hour. For a book of 350 pages, 17.5 hrs. of recording time are required. If the value of the volunteer labor is 2 @ $2.75/hr., then the labor in the transcription is $96.25. The cost of an audio-quality seven inch open reel tape is $3.40 and 9 such reels would be required for a typical book, giving the cost of tape for a book of $30.60. This material figure has to be doubled since a master and at least one duplicate copy are produced. The total, then, for one book is $157.45.

"Commercial" Braille

1.	Cost of producing master plates:	$6,500 (for 350 page book)
2.	Incremental cost per copy	$9.19
3.	Incremental binding cost	$6.00 (assume 4 vols. @ $1.50/vol.)

Assuming a typical run of textbooks at 70 copies gives a total cost for each copy of the book at $108.94. If postage had to be paid to ship this Braille book across one to seven postal zones, a shipping cost of $8 - $20 would be added.

6.0 RESEARCH NEEDS

OBJECTIVES:

6.1 Workshop Director will discuss questions which have been suggested to be researched in tactual reading.

6.11 Students will construct list of additional questions which will need to be researched in the future.

6.1

In addition to questions relating to tactual reading which have been investigated and reported in the literature, some other researchable questions have been identified:

1. What cognitive skills (and styles) affect the acquisition of Optacon reading skills in children, e.g., perceptual decoding processes and conceptual processing factors?

2. Will certain perceptual and language subtests of the WISC-R predict success?

3. What is the relative effectiveness of distributed vs. concentrated instruction for children?

4. Is there a relationship between the size of the finger (for children) and optimum image size?

5. Is there an optimum age for beginning instruction in reading with the Optacon?

6. Is the use of duplicate materials in braille and print effective for Optacon instruction?

7. What is the effect on reading of teaching braille at the same time as Optacon reading?

8. Should readiness materials which are similar to the images on the Optacon be utilized, rather than raised letters?

9. Should primary readers learn first the identification of letters on the tactile array before tracking?

10. Should critical features embossed in raised letters be included for pre-reading practice?

11. How effective is a whole word approach to reading for teaching Optacon reading?

APPENDIX

COURSE OUTLINE

1. Introduction
    1.1 Demonstration of Optacon
    1.2 History and philosophy of development
    1.3 Structure of Optacon
    1.4 Teaching aids and accessories
2. Assessment
3. Instructional Strategies
    3.1 Development of tracking skills
    3.2 Recognition of letters and words
    3.3 Speed building
    3.4 Problem solving
4. Instructional Materials
    4.1 Published Materials
        4.11 TSI
        4.12 AIR
        4.13 San Diego
    4.2 Teacher-made Materials
        4.21 Component analysis approach
        4.22 Materials for remediation
    4.3 Independent Reading
        4.31 Criteria for selection
        4.32 Evaluation of materials
5. Psychoeducational Factors
    5.1 Psychological (Individual Attitudes)
    5.2 Sociological
    5.3 Vocational implications of Optacon
6. Research Needs

TEACHING READING WITH THE OPTACON

DAILY SCHEDULE

Day 1.	a.m.:	Demonstration:	As each student follows with his Optacon, teacher demonstrates each part. Students go through check-out procedures and practice individually on pages from manual.
	p.m.:	Lecture:	History and philosophy of development Comparison with other reading machines Accessories
Day 2.	a.m.:	Lecture:	Brief presentation of Information Theory
		Participation:	Students analyze letters of alphabet for critical features.
	p.m.	Participation:	Students break into student-teacher pairs. "Teacher" works with "student" who is under blindfold, teaching capital letters only.
Day 3.	a.m.:	Participation:	Students teach each other lower case letters.
	p.m.:	Lecture:	Language Skills - Redundancy Overview of TSI, AIR, San Diego materials
		Participation:	Free tracking on TSI materials
Day 4.	a.m.:	Lecture:	Component Analysis - Curriculum design
	p.m.:	Participation:	Students form into groups and devise a component analysis of task: Read one-line sentence with Optacon
Day 5.	a.m.:	Participation:	Students practice individually free tracking on all manuals.
	p.m.:	Participation:	Students, in groups, are given component analyses and simulated problems. Students analyze problems, causes of problems, and remediation in discussion.
Day 6.	a.m.:	Participation:	Students begin investigation of library books and construction of annotated bibliography
	p.m.:	Lecture:	Discussion of speed building strategies based on component analysis, development of optimum anticipation skills, reading in meaningful units.

DAILY SCHEDULE - PAGE 2

Day 7.	a.m.:	Participation:	Students construct lesson plans. Students continue construction of bibliography.
	p.m.:	Lecture:	Screening, Record Keeping
Day 8.	a.m.:	Discussion:	Research past and future Development of motivation Evaluation
	p.m.:	WRAP UP	

SOURCES OF MATERIAL FOR OPTACON INSTRUCTION

Telesensory Systems, Incorporated
1889 Page Mill Road
Palo Alto, CA 94301

Materials:

Optacon Training Manual, Stage I, Grapheme Recognition, R17464-A
Optacon Training Manual, Stage I, Teacher's Edition
Optacon Training Manual, Stage II, R17453-A
Optacon Teaching Guidelines, R17454-A

Dr. Robert A. Weisgerber
American Institutes for Research
P. O. Box 1113
Palo Alto, CA 94302

Materials:

Optacon Instructional Materials, Primary Level
Optacon Instructional Materials, Elementary Level, 1974
Optacon Instructional Materials, Secondary Level, 1974

Mr. C. Robert Calhoun, Supervisor
Exceptional Child Program
San Diego Unified School District
6404 Linda Vista Road
San Diego, CA 92111

Materials:

ESEA Title VI-B Students' Manual for Learning Optacon Reading, 1973
ESEA Title VI-B Teachers' Manual for Optacon Reading, 1973
ESEA Title VI-B Optacon Readiness and Elementary Reading Materials, 1974

MATERIALS ADJUSTMENT PAGE

Date Teacher

1. Looking out of our front window I watched some birds busily gathering twigs and bits of straw: they were at work building nests in the treetops across the way. Each autumn the apple trees are

2. *When I was walking through the woods I saw a bear standing on his hind legs. I ran to get my gun but when I returned it had gone. Suddenly a strong gust of wind blew the man's hat off his head and dropped it in a mud puddle; he was annoyed for it was*

3. Grocer: We redeem this non-transferable coupon for face amount plus 3¢ handling only if you obtained it from customer buying this item.

4. TELESENSORY SYSTEMS, INC.
[illegible] HANOVER STREET
PALO ALTO, CALIFORNIA 94304

5. *In London there is a shop which sells stones. Few of these stones cost more than fifty pence. I know a man who always carries one of these stones. At last I have*

6. **YOUR CHOICE OF THE HIGHEST RATES**

7. AS HE SMOKED, HIS LEGS STRETCHED OUT IN FRONT OF HIM, HE NOTICED A GRASSHOPPER WALK ALONG THE GROUND AND UP ONTO HIS WOOLEN SOCK. AS HE HAD WALKED ALONG THE ROAD, CLIMBING

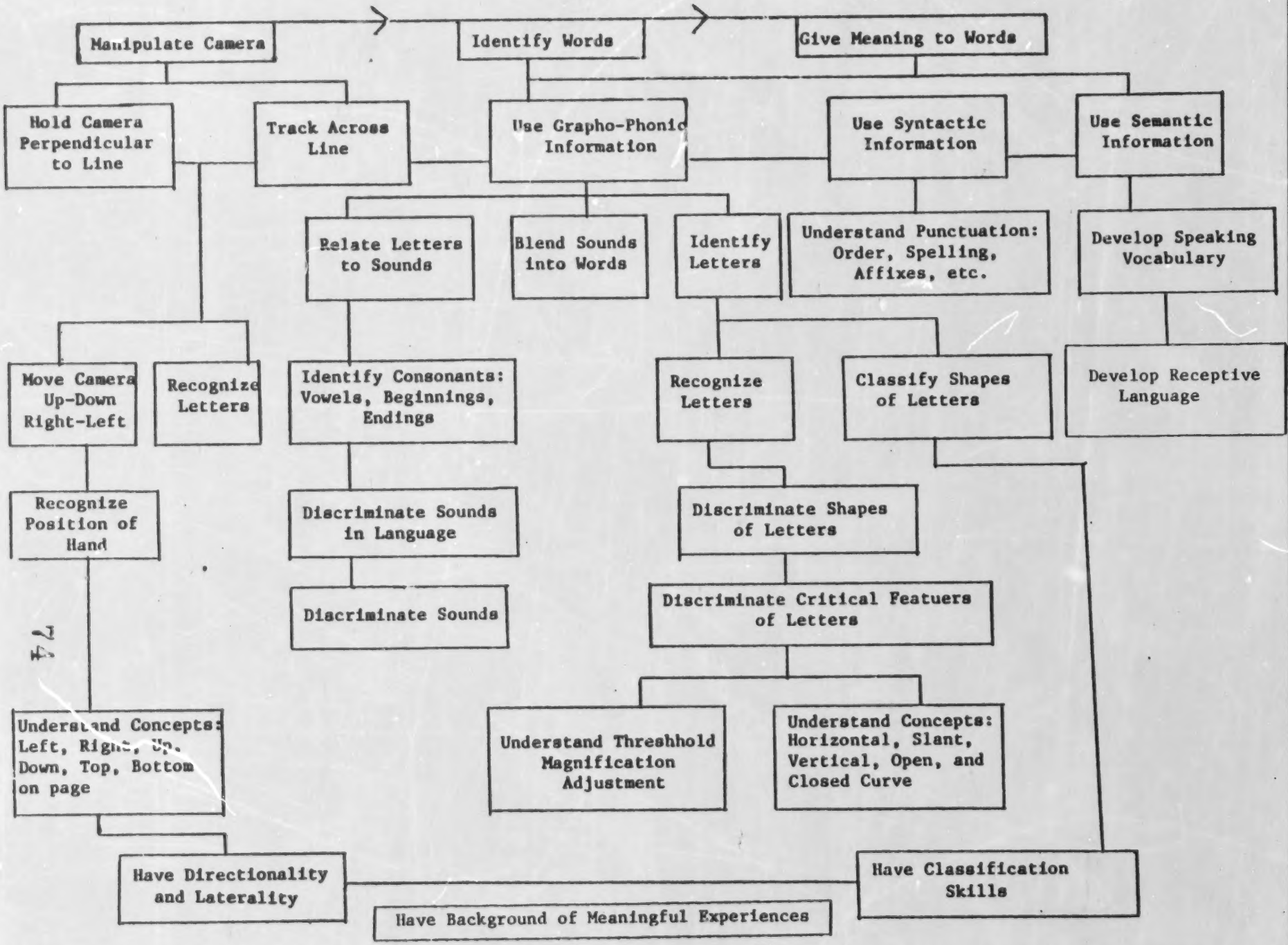
8. SPECIAL STATEWIDE ELECTION BALLOT

9. As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial

10. Older people can hardly believe their ears when they are told that schoolchildren are on strike. In our young days we would not have dared. Had we dared, the revolt would have been

11. Poppy petals are falling for the last time in a Turkish town called Opium and the people are finding it hard to get used to the idea. Harvesting of the last crop has begun. When

READ SENTENCE WITH OPTACON (ASSIGN MEANING)



OPTACON READER "EXPLORES" THE PRINTED PAGE*

Development of the Optacon, an electronic device that reproduces printed letters that can be read by touch, has produced some interesting discoveries for the cogenitally blind. In conversation with Fred Gissoni of Louisville, who has developed a speed of about 40 words a minute using the Optacon, I learned that he has discovered some things about printing he didn't know existed.

By tracing lines of type with an electronic probe, the Optacon user can feel actual shapes of letters formed under his fingertip. Because the probe will also pick up other printed marks, Fred has discovered such interesting objects as column rules, designs, and countless other things the sighted reader never mentions when reading aloud to a blind person.

"I had never known the difference between the shape of capitals and lower case letters," Fred advised. "I have often seen raised capital letters and assumed the small letters were simply smaller sizes of larger ones."

On Fred's suggestion that congenitally blind persons might be interested in a description of what is contained on the printed page other than type, I shall attempt, from my years of experience as a printer, to describe what sighted persons see on a printed page.

Nold, Don O. Dialogue with Intercom, Manuscript #48, Winter Edition, 1973. Berwyn, Illinois: Dialogue Publications, Inc. Reprinted with permission of the publisher.

TYPE FACES. Basically, there are three main families of type faces, each with hundreds of variations. Roman is used to indicate type with "serifs"--little lines or bars that are placed at the ends of letter-strokes. An "l", for example, is a straight line going up and down; at top and bottom of a capital "l" is a tiny cross line placed at 90 degrees to the main stem of the letter. Standard typewriter type usually has "serifs" and therefore is considered a member of the Roman family.

Varying faces of type have different names, often bearing the name of the designer. For example, Cheltenham is a Roman face with sharp "serifs" that are equal in width to the main body of the letter. Caslon is a graceful letter given more to gentle curves with thinner "serifs," but still in the Roman Family.

Goudy is the name given to a rounded, heavy letter with somewhat rounded "serifs" and the main stem of each letter varies in thickness, being wider near the center of each stroke and thinning as it nears the "serif" end. Memphis type, like Cheltenham, is rigidly even but with thinner "serifs." There are literally hundreds of variations, but as long as the letters have "serifs," they are considered in the Roman family.

Gothic is the name given to the other main family of type faces. Gothic is known for its simplicity, having no "serifs" or "curlicues" adorning its style. Most modern faces fall into the Gothic family, such

as Futura, Tempera, Moderne. As in Roman, there are many variations, each with its designer's characteristic flare to be different in some way from another style.

The third family is generally known as Script, characterized by its similarity to handwriting. Letters are designed with joining strokes so when type pieces are placed side-by-side to form words, they will appear to be joined in a continuous line. Again, there are as many styles and variations as one can imagine, all claiming some resemblance to Script styling.

There are still other variations in type, one of which is called "Italicizing." Italic type (pronounced "it-talic" and not "eye-talic") indicates that letters have a slight slant in contrast to the straight up and down line of the conventional letter. Italics are used to emphasize words, or for titles of books, etc. Each type style and size is produced in Italics without changing the family characteristic of the letter.

WEIGHTS AND SIZES. Shapes are not the only differences in style. While Braille is uniform in size and spacing, printer's type comes in sizes from tiny type that good eyes can hardly read to huge letters used on billboards. Small type used to conserve space on legal forms and classified ads in newspapers is among the smallest commercial type. Anything smaller

is usually drawn larger and reduced photographically, as type found in trademarks, union labels, etc.

In addition, each type face has other characteristics that alter its appearance. For example, the word "condensed" means that a type face is made narrower so more letters will fit into a given space. The word "extended" means the opposite--that letters are broadened to take up more space. In either case, the style of the letter has not been changed, but in the "condensed" or "extra-condensed" letter, the "O", for example, will be a tall oval; in the "extended" it will appear squatty, either a full circle or being actually wider than it is tall.

POINT SYSTEM. Printers use different measuring units than you are accustomed to. Type sizes are given in "points"--72 points to an inch. Small type used for classified ads in newspapers is usually six-points, meaning that from the top of a capital letter to the bottom of the tail on a small letter "g," "j," "p," "q," "y," is six points or one-12th of an inch. Set solid--that is, with no space between lines--one could get 12 lines in an inch. However, this would be very difficult to read, so such type is usually set with one or two points between lines. This is called "leading" (lĕding) because the thin pieces of metal placed between lines of type is made of lead.

Heights of letters are measured in points, but width of lines are measured in picas. There are six picas to an inch, and newspaper columns are usually 12 picas with right columns to a large size page, five columns in tabloid. Many papers are now changing to wider columns--often 20 picas--with five columns to the page. Column rules separating columns take one pica, but magazines prefer to leave more space and use no column rule--only white space separating columns of type.

Perhaps you have heard of "ems" (e-m-s) and "ens" (e-n-s). When type is hand set (something rarely done in today's automated shops) an "em" is a spacer that is as wide as the type face is high. An "en" is half an "em."

OFFSET PRINTING. Printing from metal type is rapidly disappearing, being replaced by various forms of offset printing. Done photographically, a picture is taken of a "paste-up," the full layout of a page or several pages mounted together. Cameras vary in sizes, some large enough to photograph several full newspaper pages at once, producing a negative that, after developing, is used to burn an offset plate. Only the portion to be printed--type, drawings, photos--appears clear on the negative, the part not to be printed remaining black and opaque to light. When placed over a pre-sensitized plate under a strong arc light for several minutes, the image is burned into the plate. The plate is then developed with chemicals which bring out the image to be printed. The plate is then wrapped around a solid

cylinder and as it turns on the press, two sets of rollers touch it. One applies a repellent that coats the blank area of the plate, but will not adhere to the image. The other rollers carry the ink supply, and the image to be reproduced picks up the ink, but the ink will not adhere to the blank area covered by the repellent. The principle here is that oil and water do not mix so neither do the ink and repellent mix.

When the plate is sufficiently inked, the inked plate is engaged to roll onto a solid cylinder of equal size covered by a rubber blanket. The blanketed roller picks up only the ink, which in turn is applied to paper as it passes through the press. Thus, the term "offset" is demonstrated, the print being put from the plate onto the blanket and then "offset" onto the paper. It is, in fact, a form of lithography.

WHAT THE OPTACON SEES. All kinds of images are put onto the printed page to produce special effects for advertising and color printing. Screens--a panel of dots--are used as background to type, printed in a lighter color than the darker type, producing emphasis or background to catch the reader's visual attention. Often a "reverse" is used, the type being white on a dark background so letters appear to be cut out of the page. Plain and fancy borders, rules, insignias, indescribable designs, arrows, scrolls, mortices, and hundreds of other little devices are used as "attention compellers." The

blind person, having printed material read to him, may be totally unaware of these many uses of printed gadgetry that most sighted persons take for granted. Besides, it's useless to describe these eye-catchers because the message is all that is important to one without sight. It is not until one scans a printed page with the Optacon that he becomes aware of things on a page that he cannot make out. It does not have the shape of a letter, or it may be much larger than the range of the probe used to follow the print. When color backgrounds are used, it can be more than a little confusing to the Optacon reader.

In scanning magazines, newspapers, and other printed material especially those pages having advertising, Fred Gissoni discovered the many devices used in printing. He also discovered what was meant by "layouts"--the effective use of a variety of type sizes and faces, artists' creations and photographs, use of color in both type and illustrations, and the extensive use of color in backgrounds and reverses. Even on pages of straight reading matter he discovered column and cut-off rules and other devices printers use to make a page more readable for those with sight.

It is impossible to adequately describe the unlimited possibilities--more are being invented each day--that layout artists and printers are devising to effectively catch a sighted reader's eye. But take this writer's

word for it: it must be seen to be appreciated. Perhaps the Optacon will open an entirely new concept of reading to persons without sight, but it will more than likely add to a blind person's confusion if he attempts to use it to read anything but straight reading matter.

BIBLIOGRAPHY FOR READING WITH THE OPTACON

The following annotated bibliography is designed to help the teacher establish a library of trade books which are suitable for easy reading with the Optacon, and which may be used for supplementary motivational and skill-building materials with children. The books have been rated by teachers of reading with the Optacon in four different areas: print style, format, reading difficulty, and appeal.

PRIMARY LEVEL

SERIES: ANIMAL ADVENTURE SERIES. Gene Darby, 1970, Benefic Press, 10300 W. Roosevelt Road, Westchester, IL 60153. $1.80 or $28.80 per set of 12 books

The books in this series would hold the interest of a young child. Not all of the books would be suitable, however, because of the dependence upon illustrations in many of them.

Print: Easy, sans serif, medium size, even stroke width.

Format: Some inconsistency of placement of sentences on page; too difficult for independent reading, but if help with tracking is available, could be managed.

Level: Easy, simple sentences, usually one sentence per line; use of quotation marks common.

Suitable for Optacon:

Doc, the Dog -- Level PP

Hamilton, the Hamster -- Level 1

Pudgy, the Beaver -- Level 1

SERIES: THE MONSTER BOOKS FOR BEGINNING READERS. Ellen Blance and Ann Cook, 1973, Glendale, California: Bowmar Publishers, 622 Rodier Drive. $0.95 each.

The books in this series have great humorous appeal for very young readers. In each book, the print is very large, and not all of the books can be easily read with the Optacon.

Print: Easy, sans serif, maximum size of print which makes even tracking necessary.

Format: Medium, some inconsistent placement of material on page; uneven line lengths.

Level: Easy, low level.

Suitable for Optacon:

Monster Looks for a House

Monster Goes to the Museum

Monster Goes to the City

Monster Goes to the Zoo

Monster Goes to School

Monster and the Magic Umbrella

ELEMENTARY OR PRIMARY

SERIES: MICHIGAN TRACKING PROGRAM. Ann Arbor Publishers, Campus Village Arcade, 611 Church Street, Ann Arbor, Michigan 48104

The Michigan Tracking Program is a set of workbooks designed to improve visual discrimination, reading comprehension, and related reading skills. An example of an exercise is as follows: The lower-case alphabet appears at the top of the page, and the students are directed to pick out each letter of the alphabet from eight lines of nonsense syllables, ignoring intervening letters. The Symbol Tracking Workbook and the Primary Tracking Workbook are not suitable for Optacon, however the Visual Tracking, Word Tracking, Number Tracking and Cues and Signals are interesting practice books to be used with the Optacon. The elementary levels, in general, are printed in letters (or numbers) which are too loarge for the Optacon. Later in these levels and in the second levels, the print is very good. The books are rated individually:

Number Tracking: Math 1, K. Wehrle, 1971, $2.00.

Print: Roman, but easy.

Format: Easy, but some numbers in boxes; goes from widely spaced to close together.

Multiple Tracking: Math 2, Betty Steele and K. Wehrli, 1971, $3.00

Print: Block with some serifs, good size

Format: Rows of numberals for tracking

Visual Tracking: Robert Geake, 1962, $2.00

Print: Easy, block, changing sizes within workbook

Format: Good, easy, above each selection is alphabet with space between each letter. Makes it easy to adjust before starting selection.

Word Tracking: Donald E. P. Smith, 1967, $2.00

Print: Cue in bold print, other medium to hard, many serifs, strokes of varying widths.

Format: Medium to hard; different print sizes, inconsistent placement

Cues and Signals: 1. Betty Steele, 1971, Price, $2.00.

Print: Easy, little empty space, bold, block, good size.

Format: Easy, vocabulary at end very advanced.

Cues and Signals: 2. Betty Steele, 1971, Price, $2.00.

Print: Regular, pica, good size.

Format: Vocabulary at end very advanced, but teacher could omit certain sections.

Cues and Signals: 3. Betty Steele, 1971, Price, $2.00.

Print: All lower case Roman letters, good size.

Format: Print placed nicely.

Cues and Signals: 4. Betty Steele, 1971, Price, $2.00.

Print: Easy, block print, heavy print.

Format: Easy, key words in center of line.

SERIES: MERRILL LINGUISTIC READERS, A BASIC PROGRAM. Charles Fries, et. al. Ohio: Columbus, 1966. Price $0.96 per book.

This series approaches reading from a linguistic viewpoint. Patterns of words are important, hence, Nan, pan, ran, etc. While the beginning primers are printed in type too large for Optacon, they could be reproduced to make motivational, interesting exercises for practice. Investigation of Readers 1, 2, and 3 would be profitable.

SERIES: MERRILL LINGUISTIC READERS, REFRESHER PROGRAM. Charles Fries, et. al. Ohio: Columbus, 1966. Price (about) $2.50 per book.

This series is for the very slow junior high reader. There are four books in the series, Books A, B, C and D. Books A and B are printed in easy, simple serifs, Roman print, lines are widely spaced. The material is interesting for beginning readers. Books C and D are not suitable for Optacon in their print style. Good approach to teaching Optacon.

SERIES: GINN 360 READING PROGRAM. Clymer and Martin. New York: Ginn and Company, 1973. Price (about) $3.00 per book.

This series is printed in varying print styles within each book, however, there are many stories in good block print which would be suitable for the Optacon. The approach is a whole-word approach. The Teacher's editions have outstanding directions and supplementary material for the teacher.

ELEMENTARY LEVEL

SERIES: PACESETTERS IN PERSONAL READING. Kathryn Lumley and Robert Borga. Chicago, Ill: Lyons and Carnahan Company, 1969. Price, $2.25.

This is a good series for upper elementary school readers, or grades 3-4 for the better readers. They are listed below in the order of their difficulty of reading. Print size is close to the maximum which can be read with an Optacon, and this presents some problem for tracking.

Print: Medium, some serifs and variations in stroke width, good leading.

Format: Medium, pictures on most pages, but consistent arrangement of written matter.

Level: Medium, fairly long sections and rather sophisticated vocabulary.

Suitable for Optacon:

The Fish Who Weren't and Other Stories - $2.10.

Moon City and Other Stories - $2.40.

The Thief in the Basement and Other Stories - $2.40.

SERIES: RACING WHEELS SERIES. Anabel Dean, 1972. Westchester, Illinois: Benefic Press, 10300 West Roosevelt Road. Price, $2.22 per book.

This is a high interest - low vocabulary series with great interest for junior high and senior high slow readers. The sentence structure and vocabulary is about at a level for intermediate grades. Illustrations, of which there are few, are not necessary for text interpretation. The entire set is $17.76. Those listed are most suitable.

Print: Easy, block, good thickness and size.

Format: Moderate use of pictures, but consistent spacing.

Level: Elementary school/intermediate level vocabulary.

Suitable for Optacon:

Drag Race -- Level 2

Stock Car Race -- Level 3

Indy 500 -- Level 4

SERIES: WHAT IS IT. Benefic Press, 10300 West Roosevelt Road, Westchester, IL 60153. $2.40 per book.

Understanding of the text of many books in this series depend upon the illustrations, however, three are suitable for blind children. These books will appeal to science-minded children of elementary school age. Content is interesting and informative.

Print: Easy, sans serif, large size.

Format: Some inconsistency of placement of text on page, would need guidance, not for independent reading.

Level: Easy.

Suitable for Optacon:

What Is Gravity, Fred M. King and George R. Otto, 1960.

What is Space, Elmer R. Kane and Meril C. Fellger, 1964.

What is Electric Communication, Daniel Q. Posin, 1963.

SERIES: GOOD LITERATURE FOR SLOW READERS. Martha C. Weaver and Helen Prevo. N.Y.: Frank E. Richards Company, Inc., 324 First Street, Liverpool, New York 13088, $6.00 each.

These books are re-written, high interest - low vocabulary classics prepared for slow readers. They have simplified short sentences and are divided into short chapters which makes them very suitable for beginning Optacon readers at the upper elementary - junior high school level.

Print: Easy, simple serifs or gothic, even thickness, consistent.

Format: Text format is easy with consistent margins, spacing, and print placement. Pictures appear at beginning of chapters or on full pages.

Level: Grades 4 - 6

Suitable for Optacon:

Twenty Thousand Leagues Under the Sea,

Beautiful Joe, Marshall Saunders, 1967.

Freckles, Gene Stratton-Porter, 1967.

Suitable for Optacon (continued):

* The Adventures of Tom Sawyer, Mark Twain, 1967.

Heidi, Johanna Spyri, 1967

Treasure Island, Robert Louis Stevenson, 1967.

Swiss Family Robinson, Johann Rudolf Wyss, 1967.

The Prince & the Pauper, Mark Twain, 1967.

Little Women, Louisa May Alcott, 1966.

Ivanhoe, Sir Walter Scott, 1967.

* Best of the Series

SERIES: THE HOLT BASIC READING SYSTEM. Eldonna L. Everetts, Lyman C. Hunt, Bernard J. Weiss, New York: Holt, Rinehart, and Winston Inc., 1973.

This reading series is printed in varying print within each book, however, there are many stories which are in good block print which could be used with the Optacon. There is a moderate use of pictures. These books will provide valuable practice stories. The following have been reviewed:

A Time for Friends, Level 8, Price, $2.67

People Need People, Level 9, Price, $2.76

HOW SPORTS BEGAN. The Danbury Press, 1972, The Starting Point Library, Price, $1.50.

This book, for upper elementary or junior high children, would be most suitable for children with high sports interest. Illustrations are not needed for understanding.

Print: Easy, most block with some simple serifs.

Format: Easy, pictures all at the top, two-three sentences per page.

Level: Easy for elementary school age.

MARTIN MOONEY'S MINUTE MYSTERIES, CASEBOOK #3. Robert Monson and Edgar Johnson, Cambridge, Mass.: Educators Publishing Service, Inc., 1967, Price, $0.60.

This is an excellent book for Optacon readers. The interest level is high and illustrations are not needed for comprehension of text.

Print: Medium difficulty, pica, about 14 point, narrow stroke widths.

Format: Easy, print is consistent, pictures always on the left-hand page.

Level: Vocabulary for upper elementary school age.

THE TAIL WHO WAGGED THE DOG. Robert Kraus. Windmill Paperbacks, New York: E.P. Dutton, Company, 1971, Price, $0.95.

This is a humorous book with appeal for younger elementary school aged children.

Print: Easy, simple serifs, medium size.

Format: Medium, large pictures on each page, sentences above or below pictures.

Level: Easy vocabulary for younger children.

HAILSTONES AND HALIBUT BONES. M. O'Neil and L. Weisgard, New York: Doubleday and Company, 1961.

Print: Easy, simple serifs, medium size

Format: Easy, consistent, verse.

Level: Higher elementary or junior high school level.

JUNIOR THE SPOILED CAT. Robert Kraus. Windmill Books, New York: E. P. Dutton Company, 1955.

This book is humorous and will interest the child. As in most print books, the pictures are placed inconsistently on the pages, and the print test material is hard to find.

Print: Easy, block print, medium size.

Format: Hard, independent tracking will be difficult.

Level: Easy, short sentences, elementary vocabulary.

BLACK BEAUTY. Anna Sewell, New York: Frank E. Richards Company, 324 First Street, Liverpool, 13088, 1969. Price $2.65

This is a simplified text written at the low vocabulary level for elementary school age, or for slow readers. There is a practice manual in the back which could be utilized by the teacher for developing comprehension.

Print: Stories are in Roman type, simple serifs, large type and some variation in thickness of stroke. Story titles are in block type, very thick.

Format: Text format is easy, with consistent margins and spacing

Level: High interest-low vocabulary of interest to junior high, beginning Optacon readers.

THE CAMEL WHO TOOK A WALK. Jack Tworkov, New York: E. P. Dutton Company, 1971, Price $1.25

This is an interesting story for younger, elementary school aged children. While the pictures are delightful, the text does not depend upon the child being able to see the illustrations. There are many visually oriented terms employed, which would give the teacher an opportunity to enlarge the conceptual base of the child.

Print: Easy, large print, block style, even stroke width.

Format: Medium, first page of story inverted, one page with all capitals.

Level: Medium, short selections, simple sentence structure.

SERIES: SPRINT LIBRARIES. Scholastic Book Services, 904 Sylvan Avenue, Englewood Cliffs, New Jersey 17632. Prices as listed

A high motivation reading program for 4th-6th grade students reading at levels of 2.0-3.4. The reading level of each paperback book is controlled. Reading for level 2: 2.5-2.9. Reading for Level 3: 3.0-3.4.

Print: Very good block print, good contrast.

Format: Excellent. Consistent placement of pictures, some full pages.

Level: Advertised for 4th-6th grade, but would interest jr. high.

Suitable for Optacon: Sprint Library 1 Price $1.30 each

Get the Man to Second

Big Bill
Fear
The Case of the Missing Money
The Great Subway Chase

Suitable for Optacon: Sprint Library 2 Price $1.60 each

Flood
Ghost of the Dutchman
Sam, Where Are You?
The Thirteenth Floor
The Homesteaders

Suitable for Optacon: Sprint Library 3 Price $1.80 each

Lily the Lovable Lion
The Hidden Box Mystery
Sea Lab
The Trail Blazers
Secret Radio Messages

KNOW YOUR WORLD. Xerox Eduation Publications, Education Center, 1250 Fairwood Avenue, Columbus, Ohio. 43216. Newspaper issued 30 times during school year, weekly. Single subscription rates on orders totaling less than 10 copies, $3.90 per year.

This newspaper is printed in sans-serif block print with good contrast. Includes news, stories, riddles, puzzles and word games. Elementary reading level. High interest for elementary and junior high school. Excellent.

JUNIOR HIGH AND HIGH SCHOOL LEVEL

SERIES: THE ACTION LIBRARIES. Scholastic Book Services, 904 Sylvan Avenue, Englewood Cliffs, New Jersey 07632. $1.60 each.

These paperback books were expressly created to meet the special urgent need for truly readable, mature material at the reading levels of 2.0-4.0. Reading for Level 1: 2.0-2.4. Reading for Level 1-A: 2.0-2.4. Reading for Level 2:2.5-2.9. Reading for Level 3: 3.0-3.4. Reading for Level 4: 3.5-3.9.

Print: Very good block print, good contrast.

Format: Excellent. Consistent placement of pictures; some full pages.

Level: Advertised for juniur high through 12th grade.

Suitable for Optacon: Action Library 1

The Ratcatcher of Whitestone
The '50 Ford
The House that Half-Jack Built
A New Life for Sarita
The Silver Dollar Mystery

Suitable for Optacon: Action Library 1-A

The Carnival Mystery
Lane Four
The Zero People
The Chase
That Face in the Mirror

Suitable for Optacon: Action Library 2

The Girl Who Knew Rule One
One Punch Away
Crash at Salty Bay
The Race Driver
No Girls Allowed

Suitable for Optacon: Action Library 3

Cop's Son
Witches Get Everything
Rodeo Road
Skyjacked
Wade's Place

Suitable for Optacon: Action Library 4

The House on Willow Street
Crazy George
The Day After Tomorrow
The Break-In
Dead Start Scramble

SERIES: IMPACT SERIES. Holt, Rinehart & Winston, Box 3323 Grand Central Station, New York, New York, 10017

This series has been especially recommended by teachers. At this time, we have no analysis of the books.

Level 1: Price $2.22

I've Got a Name, Brooks & Trout, 1968

At Your Own Risk, Trout & Pierson, 1968

Cities, Stull & Greenfield, 1968

Larger Than Life, Stull & Sharpe, 1968

Level 2: Price $2.49

Unknown Works, Trout, 1969

Conflict, Trout & Flanigan, 1969

Sight Lines, Moore & Flanagin, 1969

Search for America, Brooks, 1969

Level 3: Price $2.76

Turning Point, Lacampagne, 1970

I (Me), Trout, 1971

Nobody - But - Yourself, Sharpe, 1972

On Edge, Trout, 1973

A STEP-BY-STEP APPROACH TO LEARNING HOW TO FILL OUT APPLICATION FORMS, Benjamin Piltch. Frank E. Richards Publishing Company, Inc., Phoenix, New York 13135. Price $1.50

This is an excellent book for teaching how to fill out forms of different types.

Print: Large block print throughout. Excellent contrast.

Format: Each page contains a different style form to be completed.

Level: High School level. Book would be excellent for pretraining in the use of the Optacon with the typewriter attachment.

END